Armed Forces College of Medicine

AFCM

Practical-1

(Receptors and Spinal Cord)

Prof. Dr. Manal Hassan

INTENDED LEARNING OBJECTIVES (ILO)

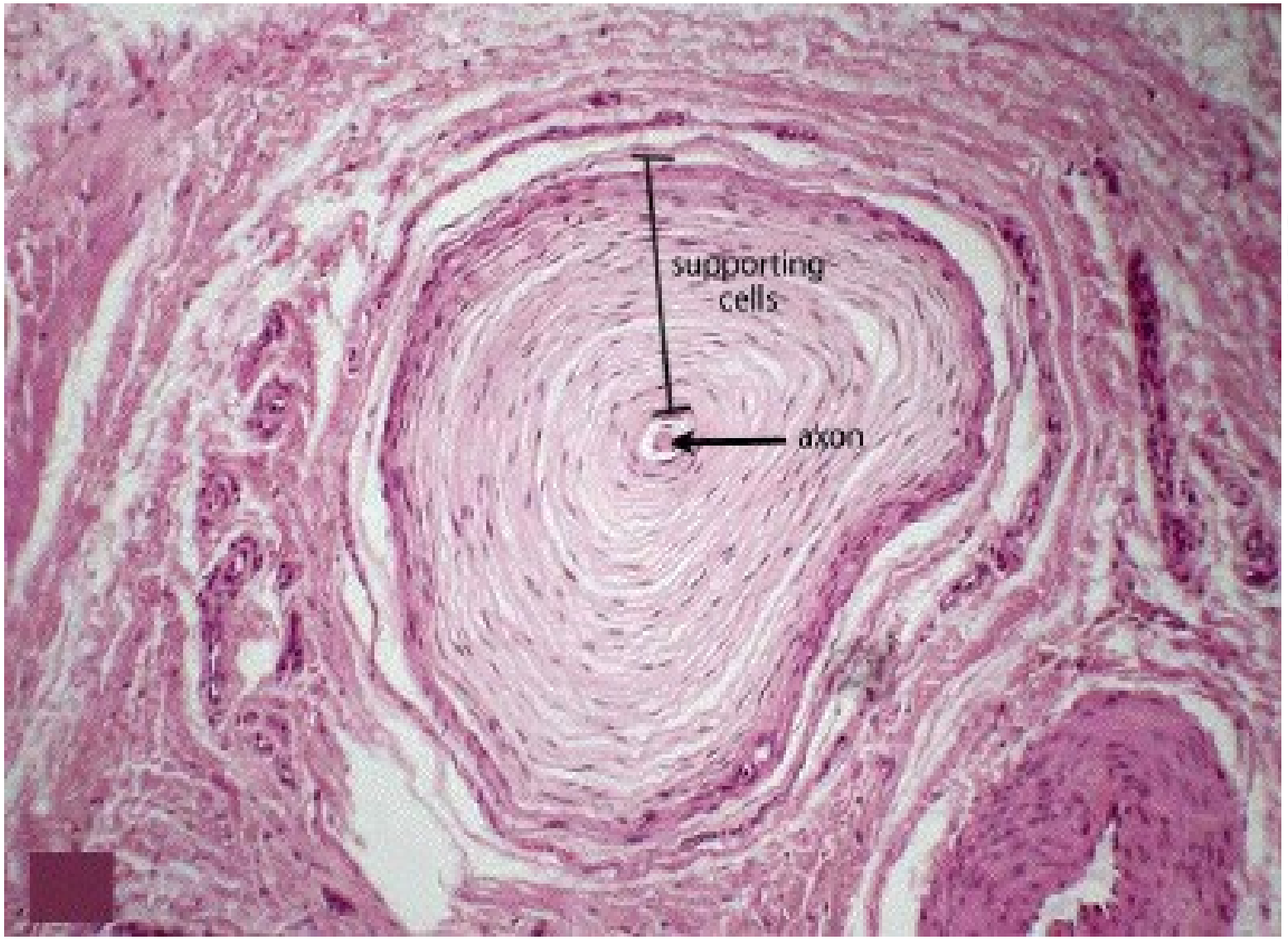
By the end of this practical session, the student will be able to:

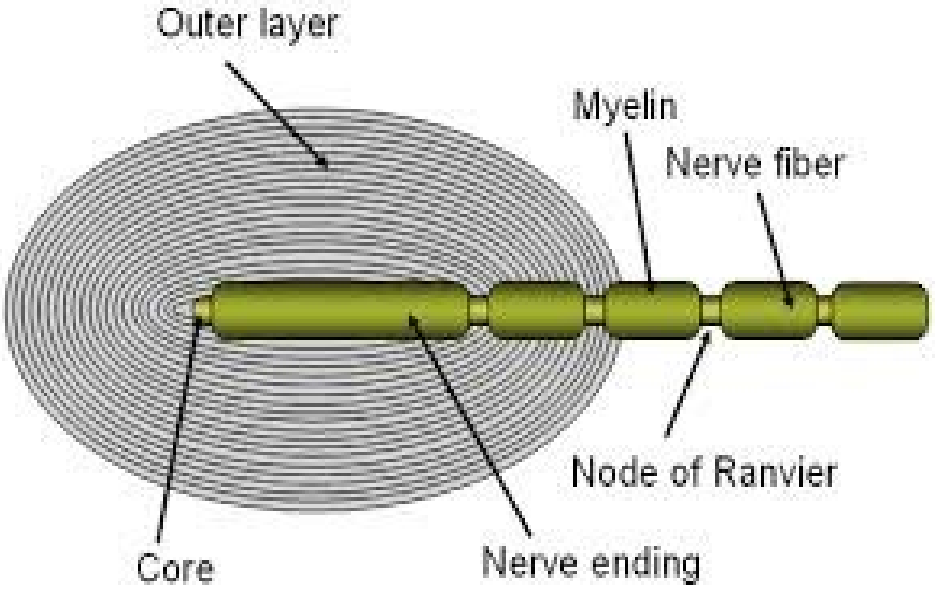
1. Identify the light microscopic structure of:
- **Pacinian corpuscles,**
- **Meissner's corpuscles**
- **Muscle spindle**

2. Identify level and stain in of spinal cord at cervical, thoracic and lumbar levels by naked eye appearance.

3. Label components of white and grey matter in different levels of spinal cord diagrams.

Pacinian corpuscle

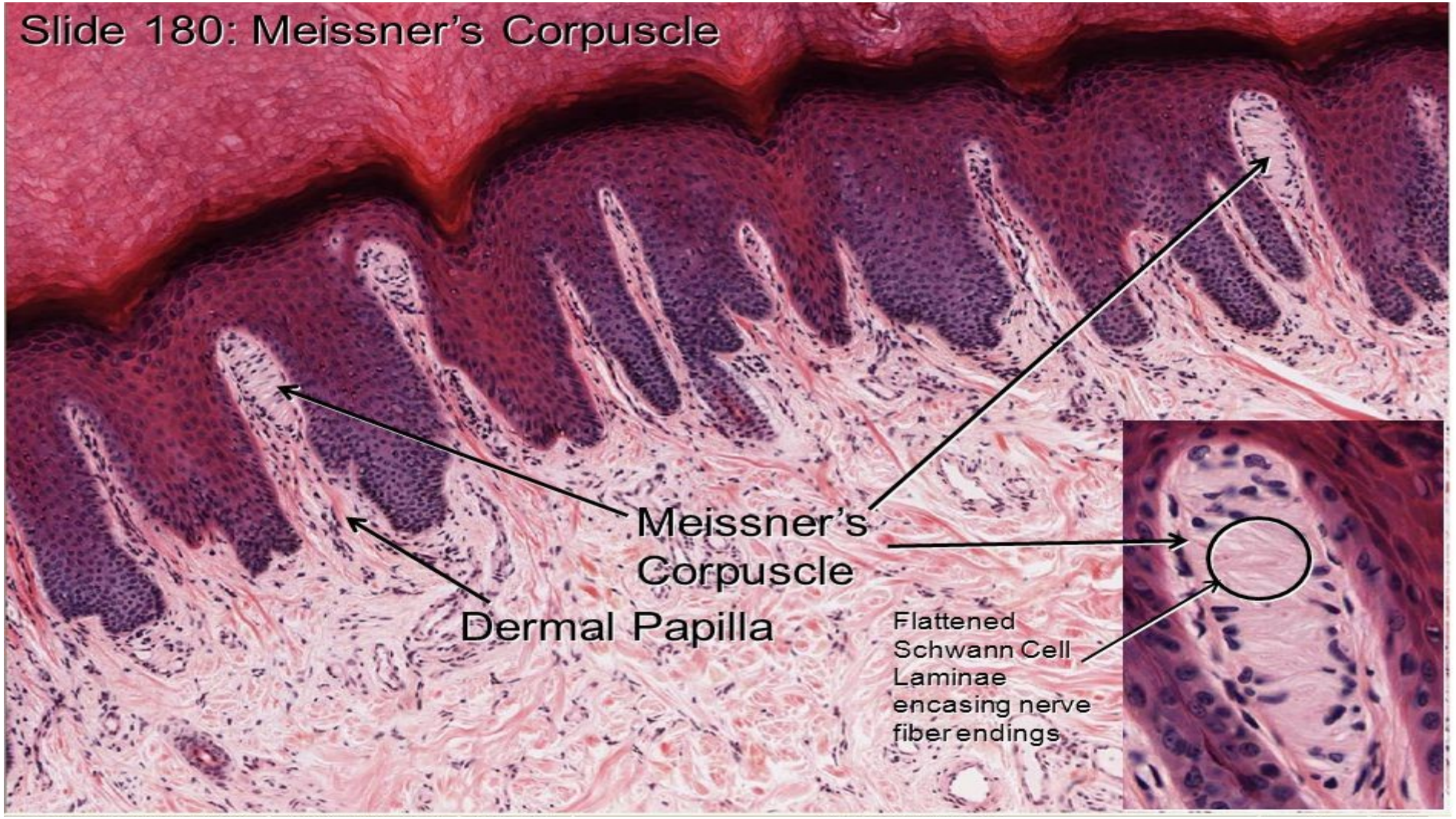




- **Large, oval structure.**
- **At the reticular dermis.**
- **Have an outer capsule.**
- **Formed of concentric lamellae of flattened Schwann cells and collagen surrounding an unmyelinated axon.**

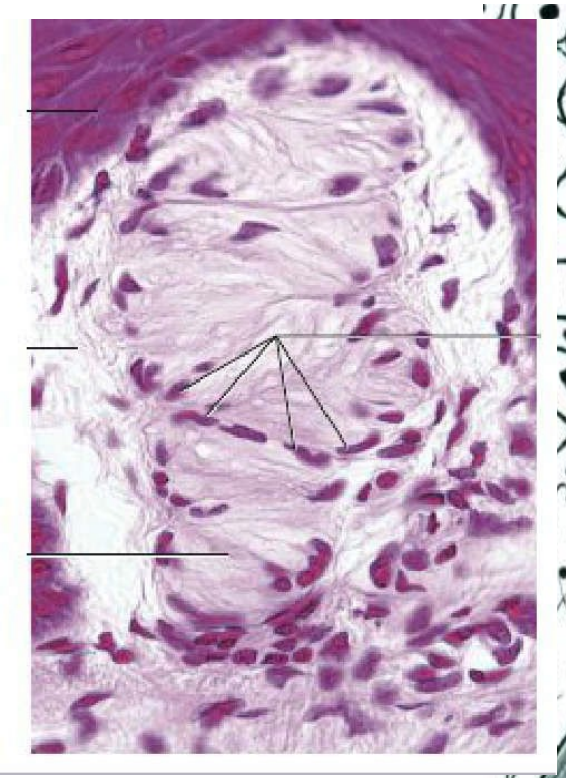
https://www.dartmouth.edu/~anatomy/Histo/lab_3/neuro/DMS033/popup.html

Meissner’s corpuscle


Slide 180: Meissner’s Corpuscle
Meissner’s Corpuscle
Dermal Papilla
Flattened Schwann Cell Laminae encasing nerve fiber endings

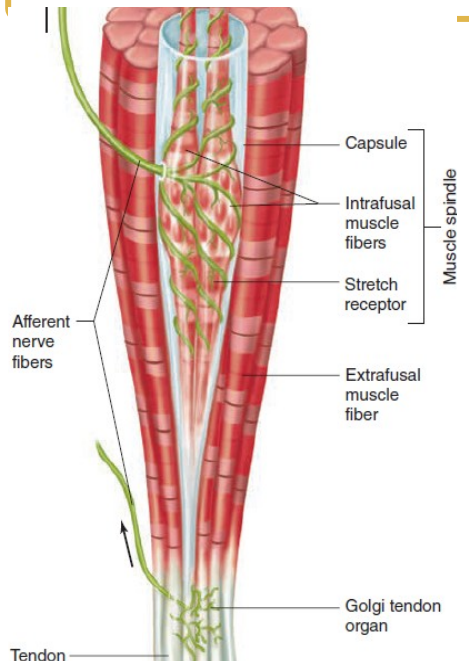
https://slideplayer.com/slide/5224308/

Meissner's corpuscle ----- silver stain



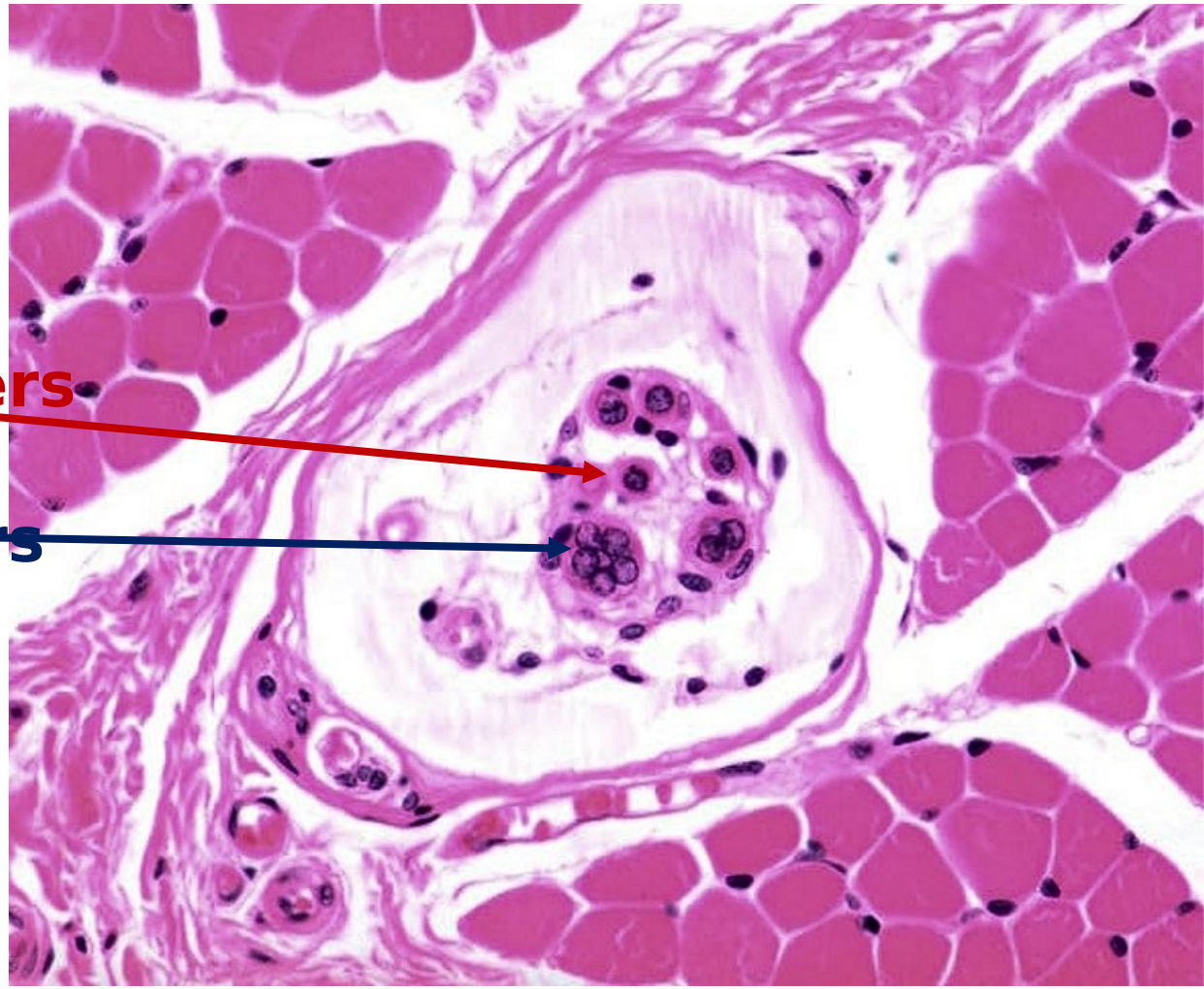
- Elliptical structure.
- At the dermal papillae
- Flattened Schwann cells.
- Sensory fiber running spirally among Schwann cells.

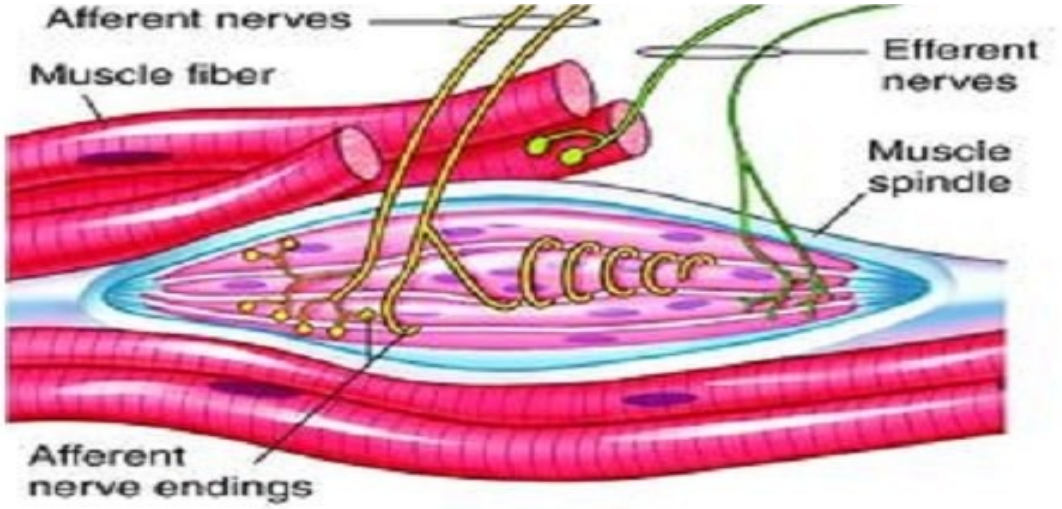
Muscle spindle



Nuclear chain fibers

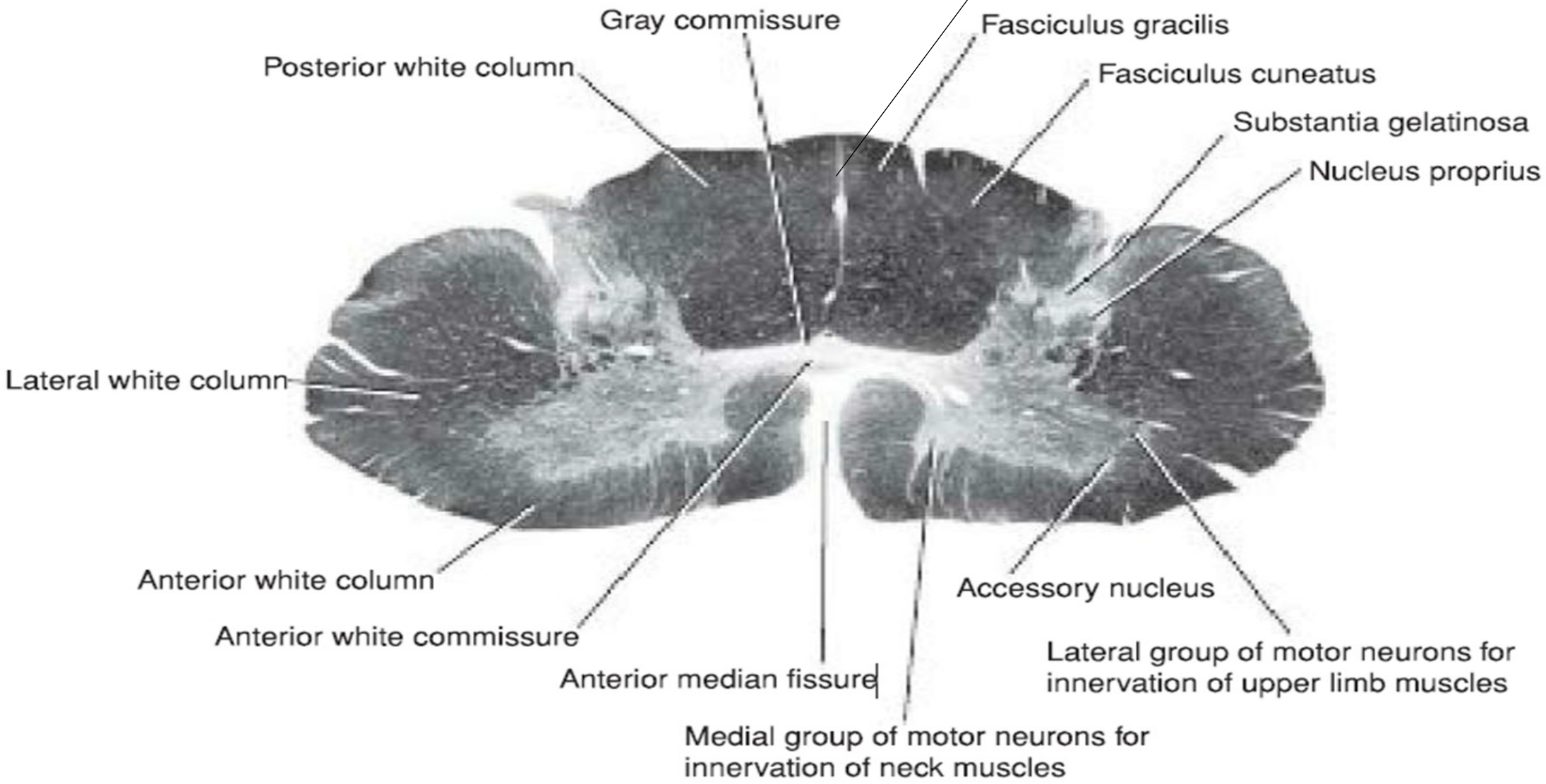
Nuclear bag fibers





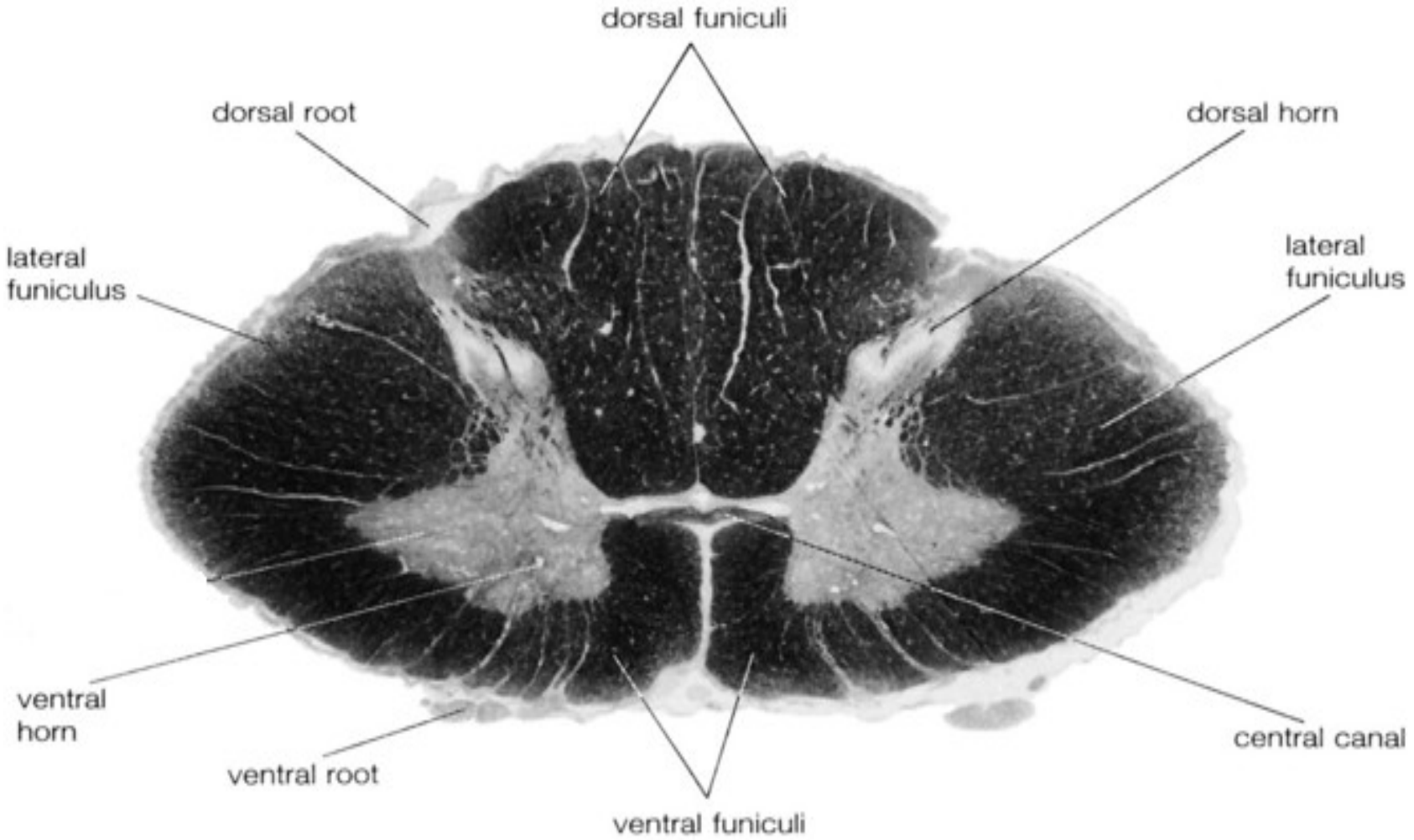
General topography of the spinal cord

2 symmetrical halves



Spinal cord- Cervical level

Wiegert Pal stain

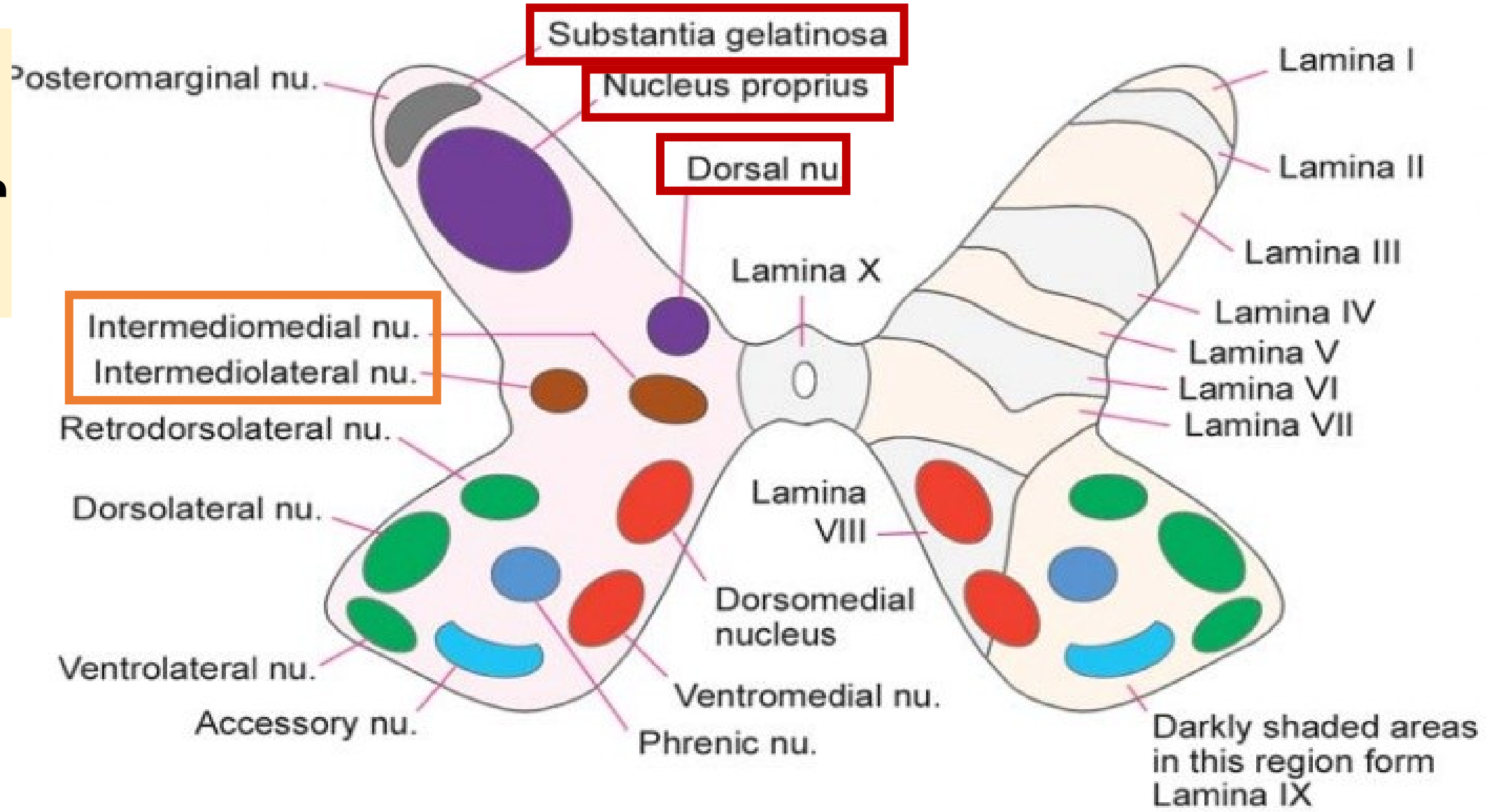


Cervical Level	
Large	**Size**
Oval	**Shape**
Thin, divergent	**Posterior horn**
Thick	**Anterior horn**
No	**Lateral horn**
Greater in amount	**White matter**

Grey matter of the spinal cord

Sensory

Motor



Spinal Cord: White matter: Tracts

Tracts of spinal cord

Long tracts

Ascending tracts

Proprioception
1- Conscious:
Gracile &
Cuneate
2- Unconscious:
Dorsal
spinocerebellar
Ventral

Exteroception

Descending tracts

Pyramidal tract
(corticospinal)

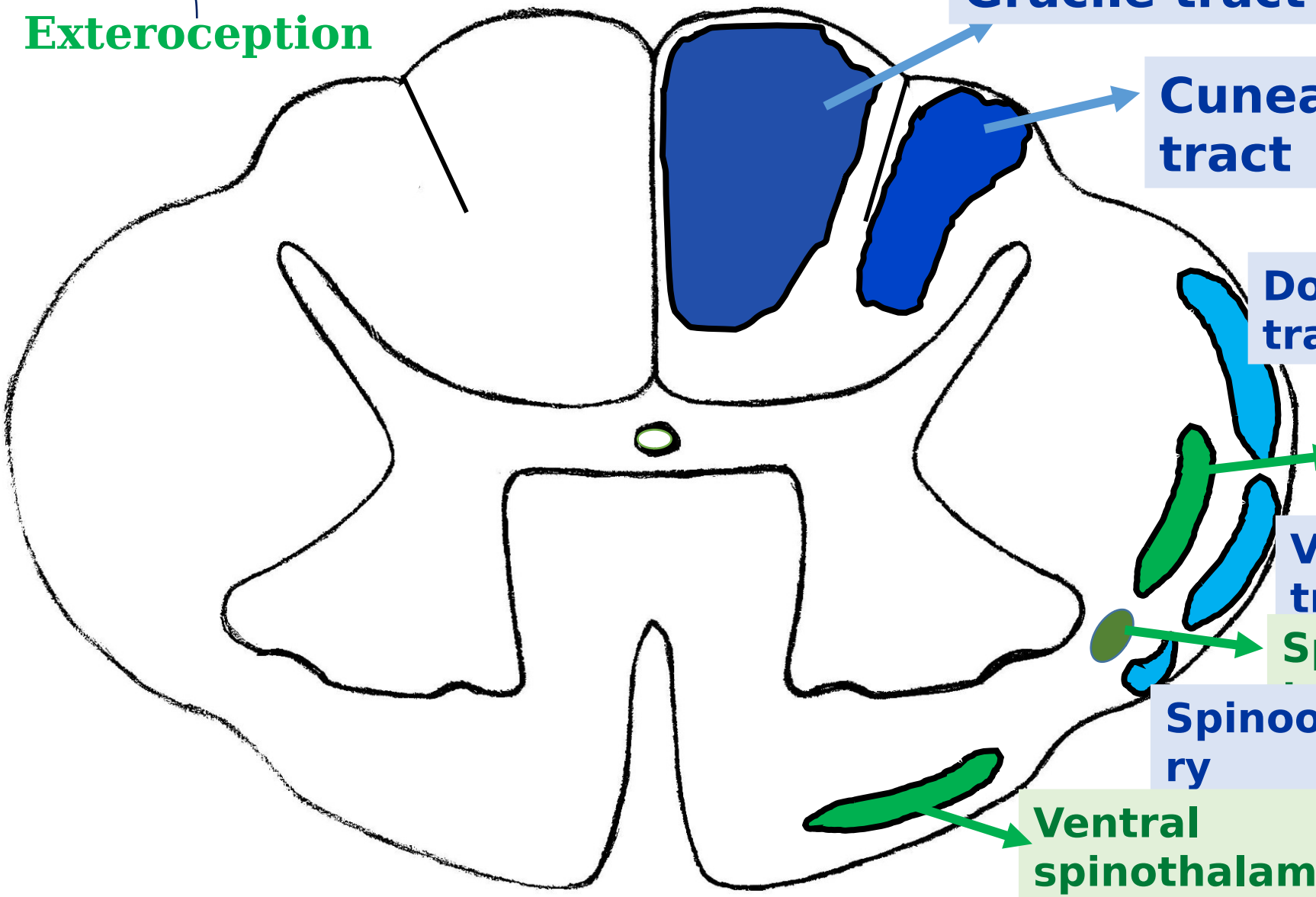
Extrapyramidal tracts
1-Tectospinal tract,
2- Rubrospinal tract
3- Vestibulospinal tract,
4-Pontine reticulospinal
,
5-Medullary

Short tracts (Intersegmental)

Ascending Tracts

Proprioception

Exteroception



Gracile tract

Cuneate tract

Dorsal SC tract

Lateral spinothalamic

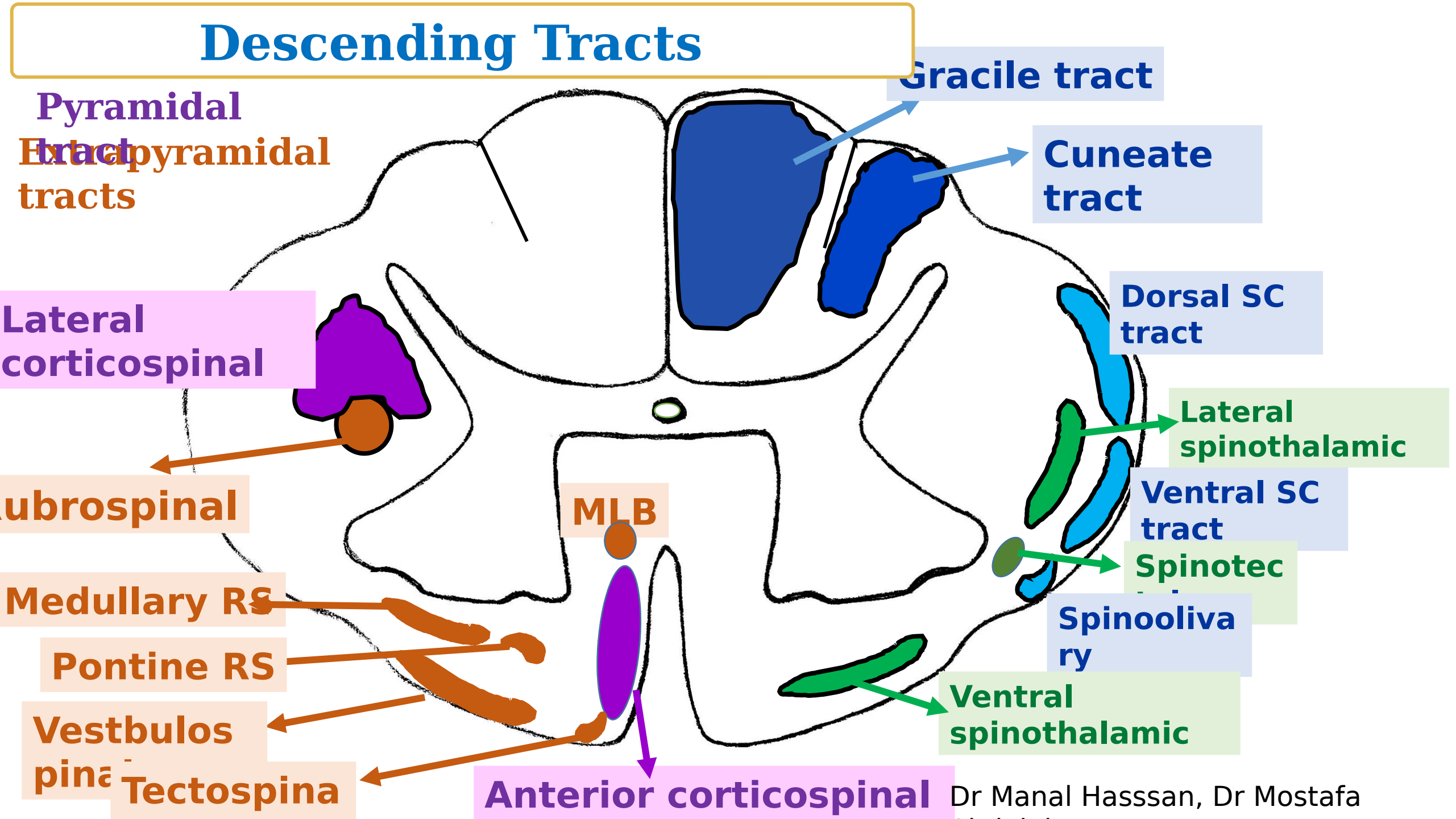
Ventral SC tract

Spinotec

Spinooliva ry

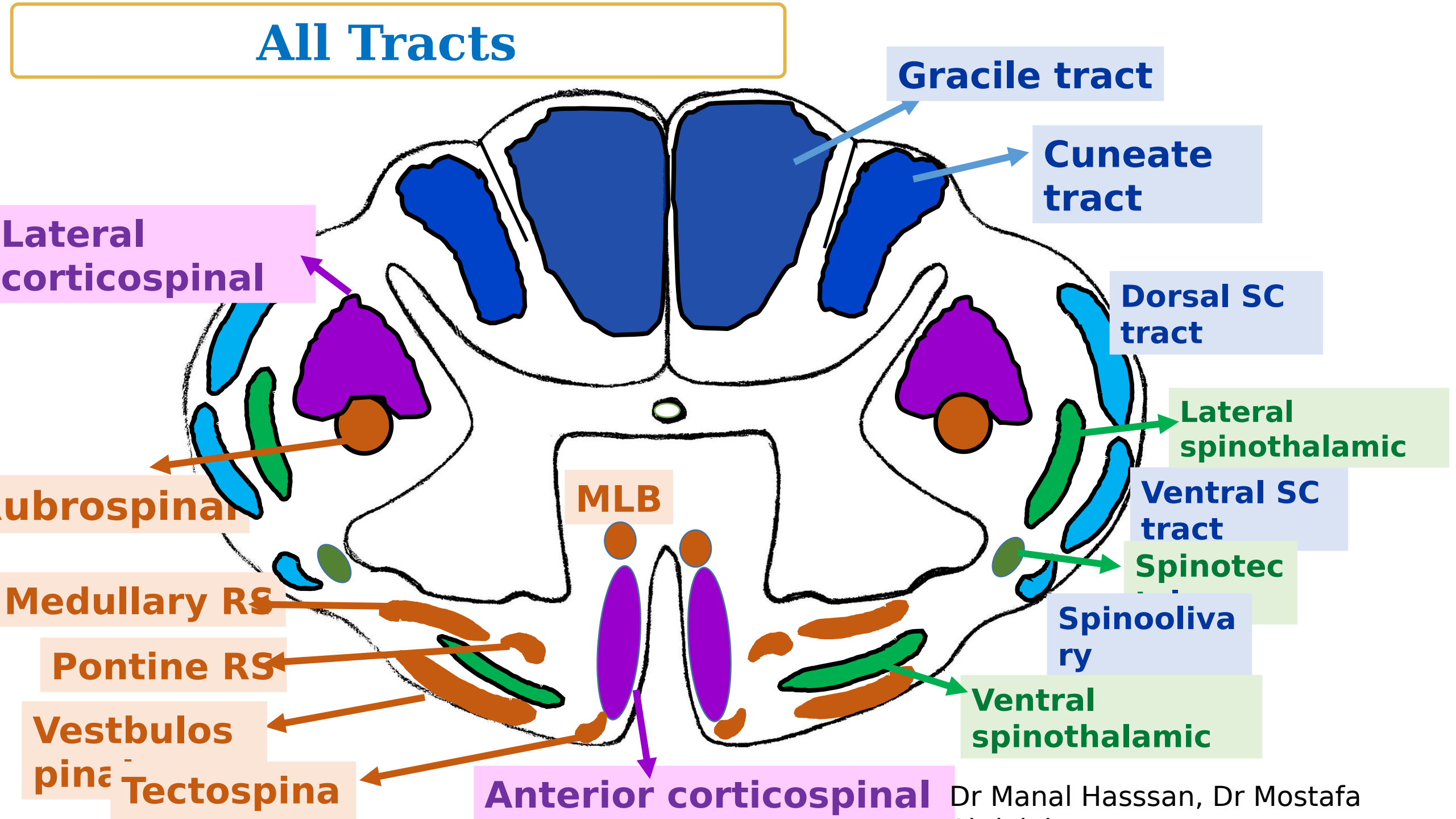
Ventral spinothalamic

Descending Tracts

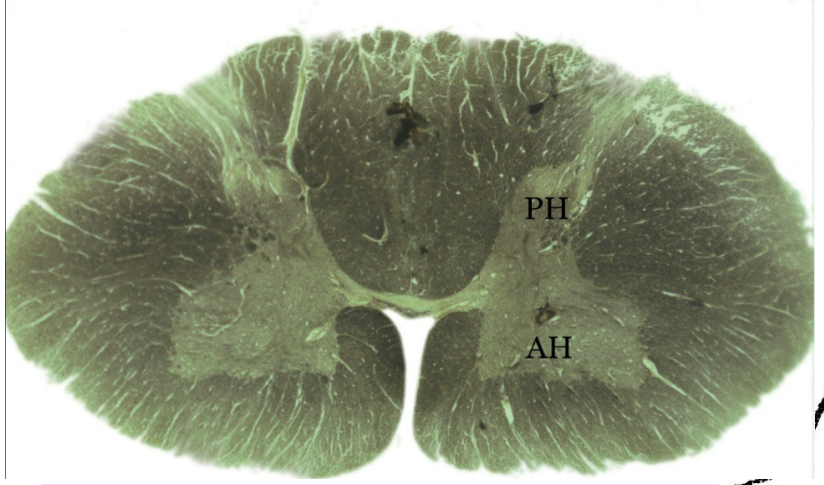


Dr Manal Hasssan, Dr Mostafa

All Tracts



Dr Manal Hasssan, Dr Mostafa



Gracile tract

Cuneate tract

Lateral corticospinal

Dorsal SC tract

Lateral spinothalamic

Rubrospinal

MLB

Ventral SC tract

Spinote

Medullary RS

Spinooliv ary

Pontine RS

Ventral spinothalamic

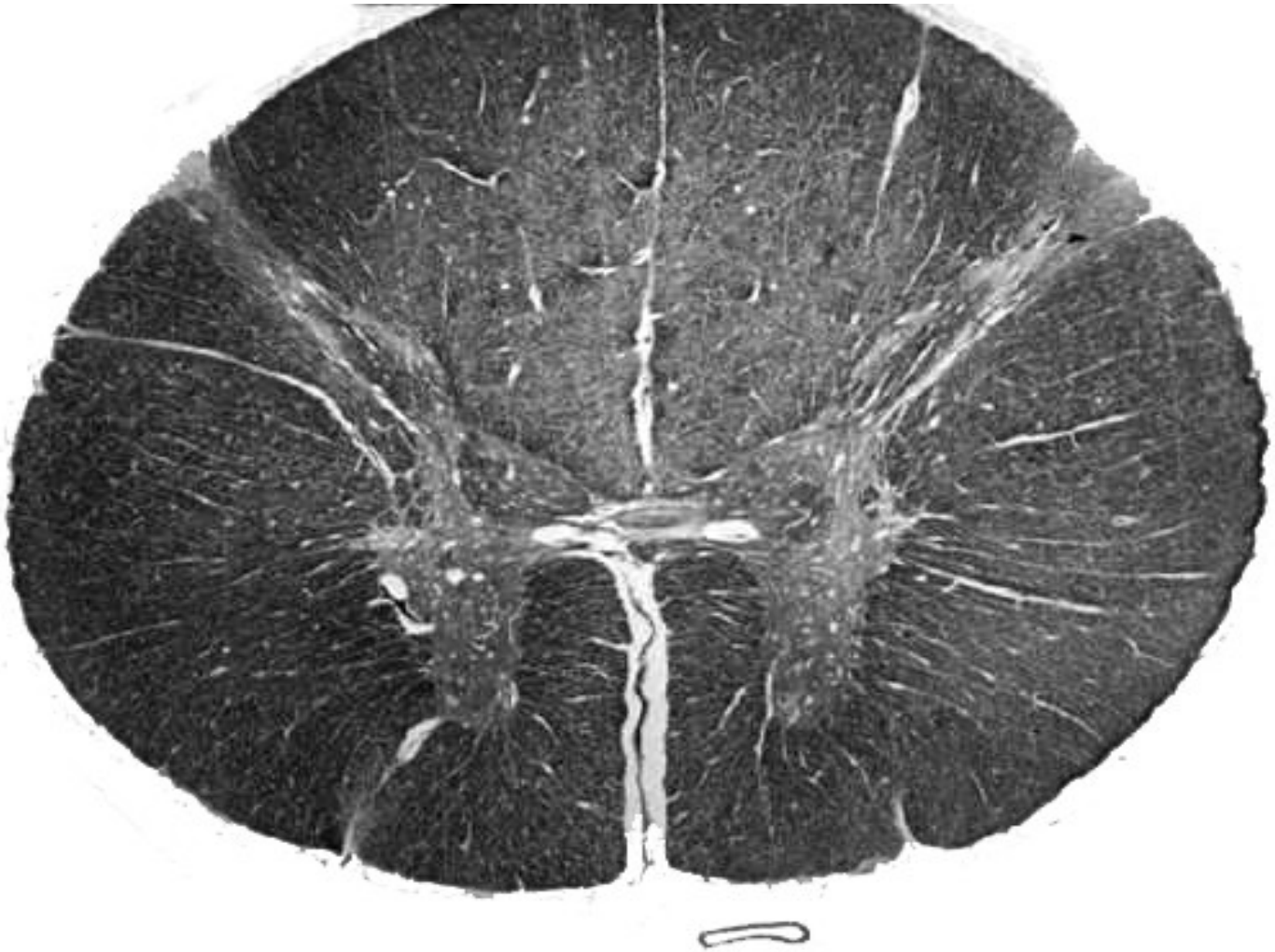
Vestbulos pinal

Anterior corticospinal

D Manal Hasssan, D Mostafa

Spinal cord- Thoracic level

Wiegert Pal stain



Thoracic Level	
Small	**Size**
Rounded	**Shape**
Thin	**Posterior horn**
Thin	**Anterior horn**
Present	**Lateral horn**
Less than cervical	**White matter**

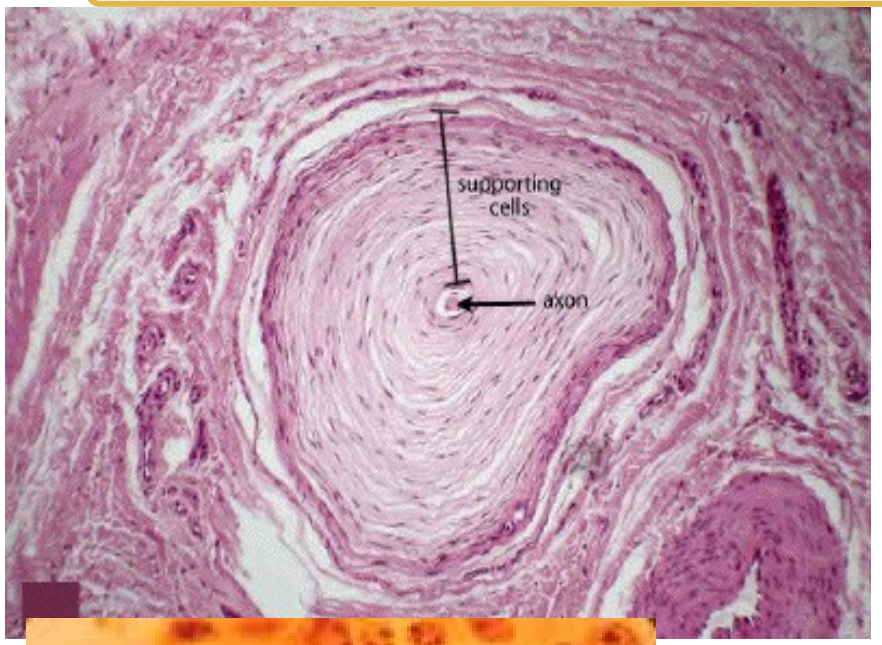
http://learn.chm.msu.edu/NeuroEd/NOP552/files/Atlases/humanatlas/spinalcordatlas/thoracic_unlabeled.html

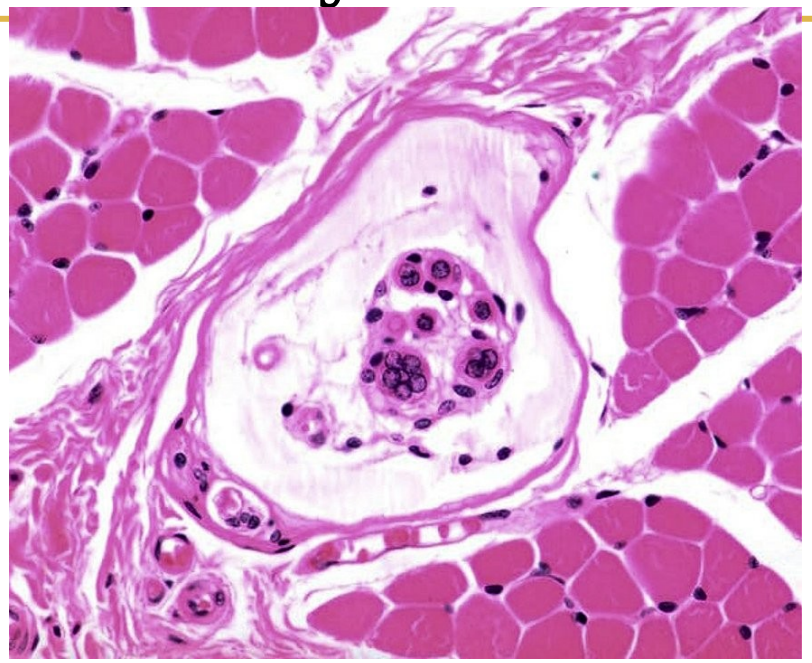
Spinal cord- Lumber level

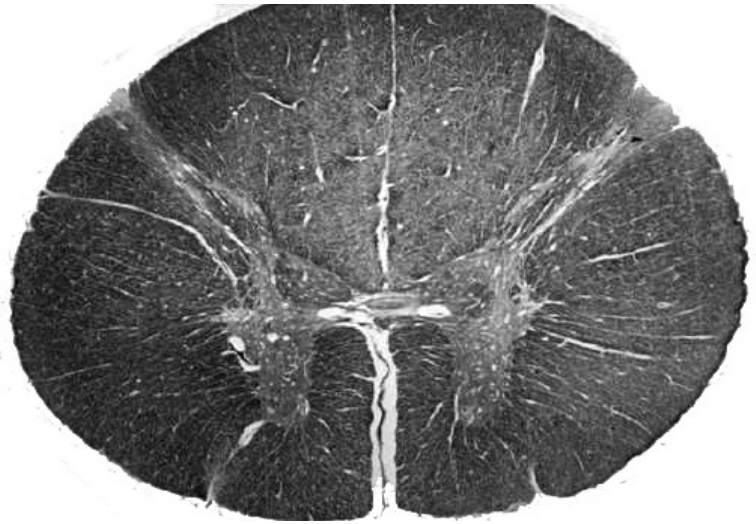
Wiegert pal stain

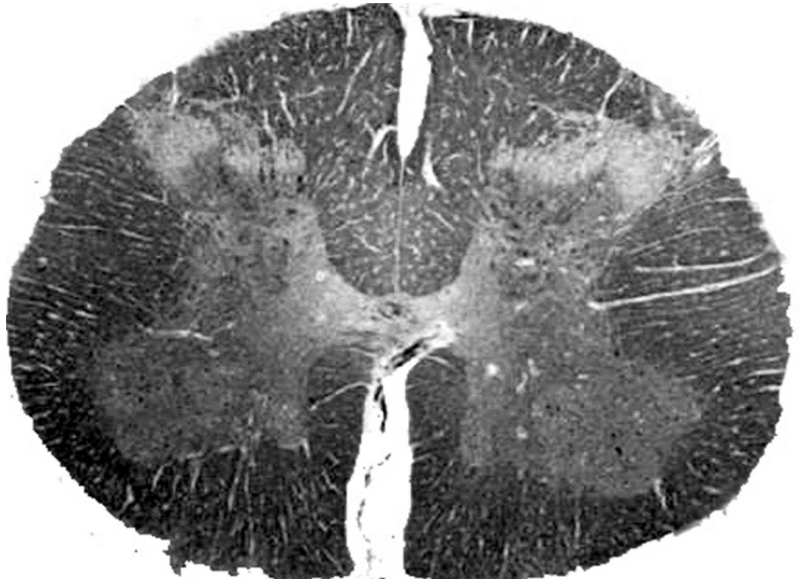
Lumber Level	
Large	**Size**
Rounded	**Shape**
Thick	**Posterior horn**
Thick	**Anterior horn**
NO	**Lateral horn**
Less than cervical	**White matter**

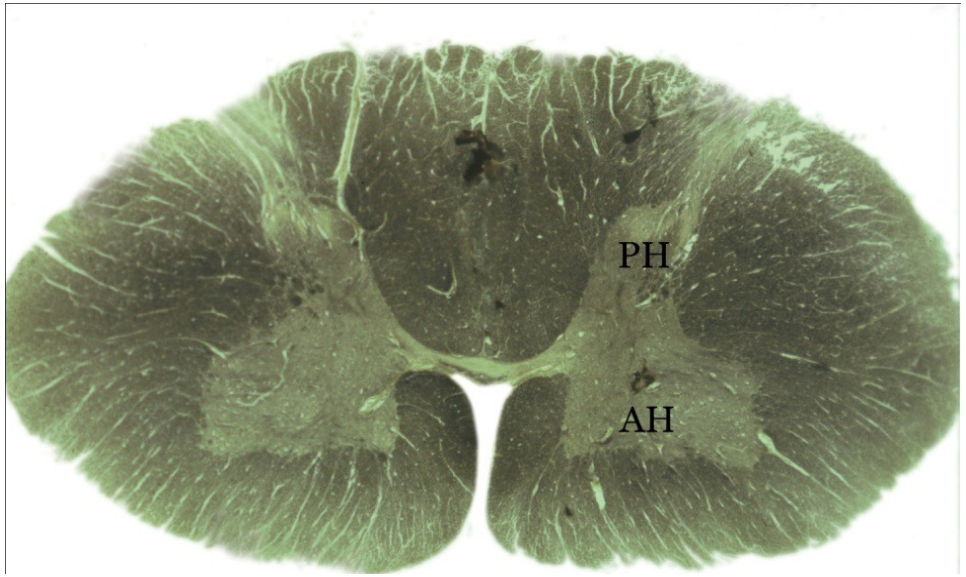
Test yourself



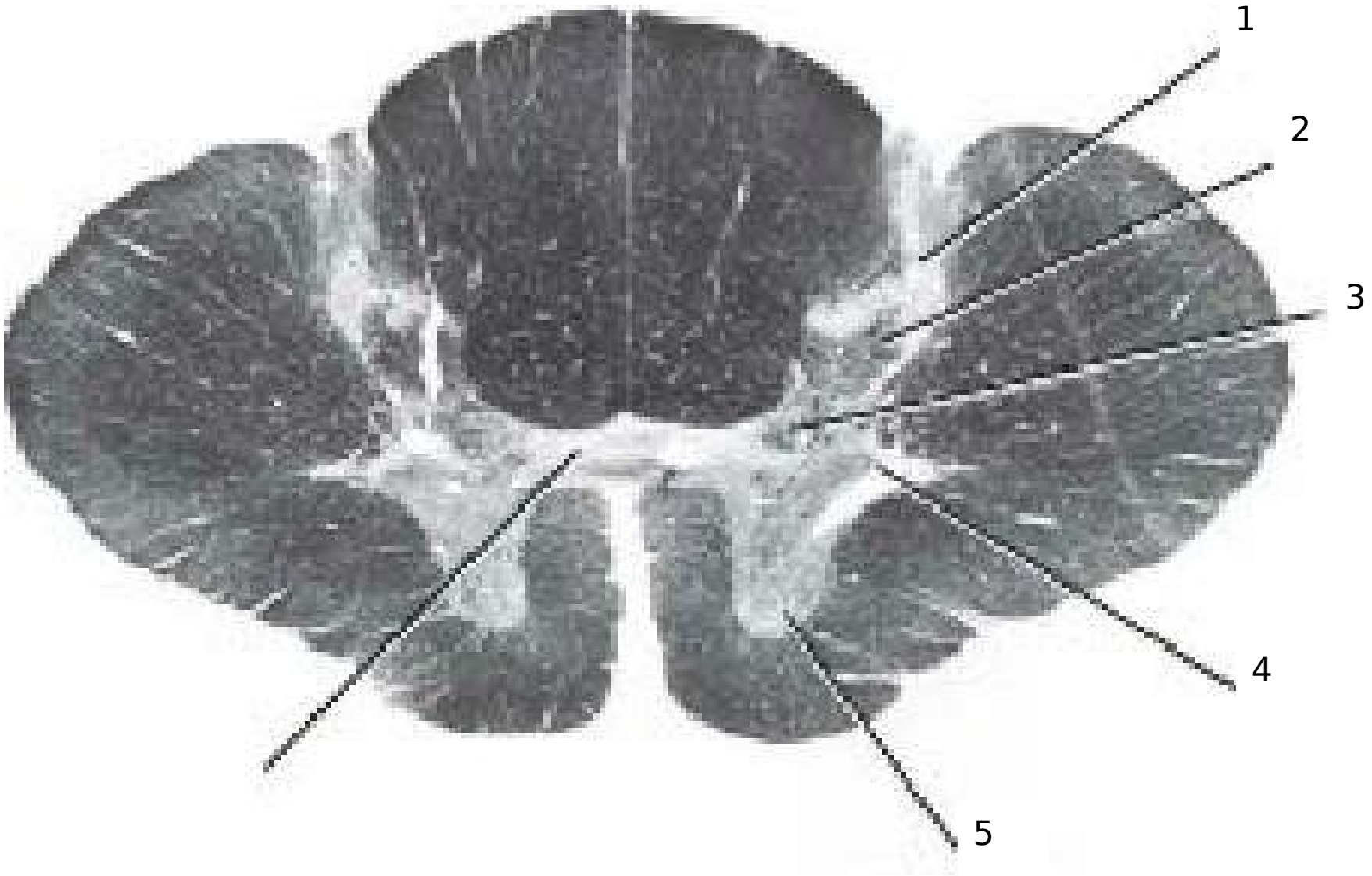








Label the following

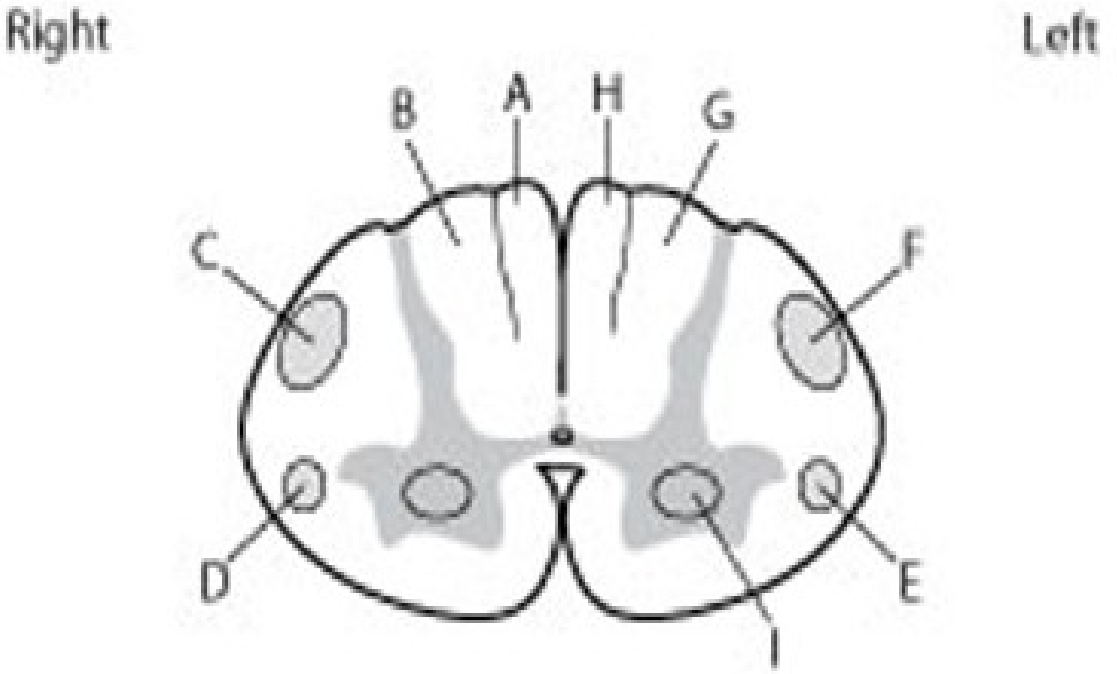


Formative exam

Quiz

A patient has a loss of tactile discrimination and position and vibratory sensation in his right arm. What is the most likely location of this lesion?

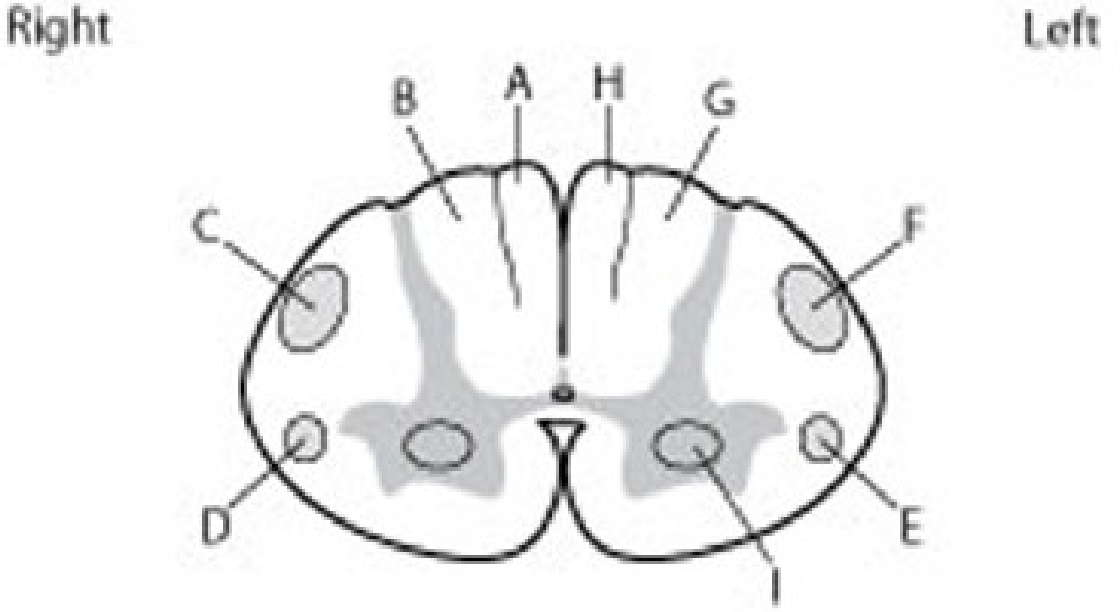
a. A
b. B
c. C
d. D
e. G



Quiz

A patient has a loss of tactile discrimination and position and vibratory sensation in his left leg. What is the most likely location of this lesion?

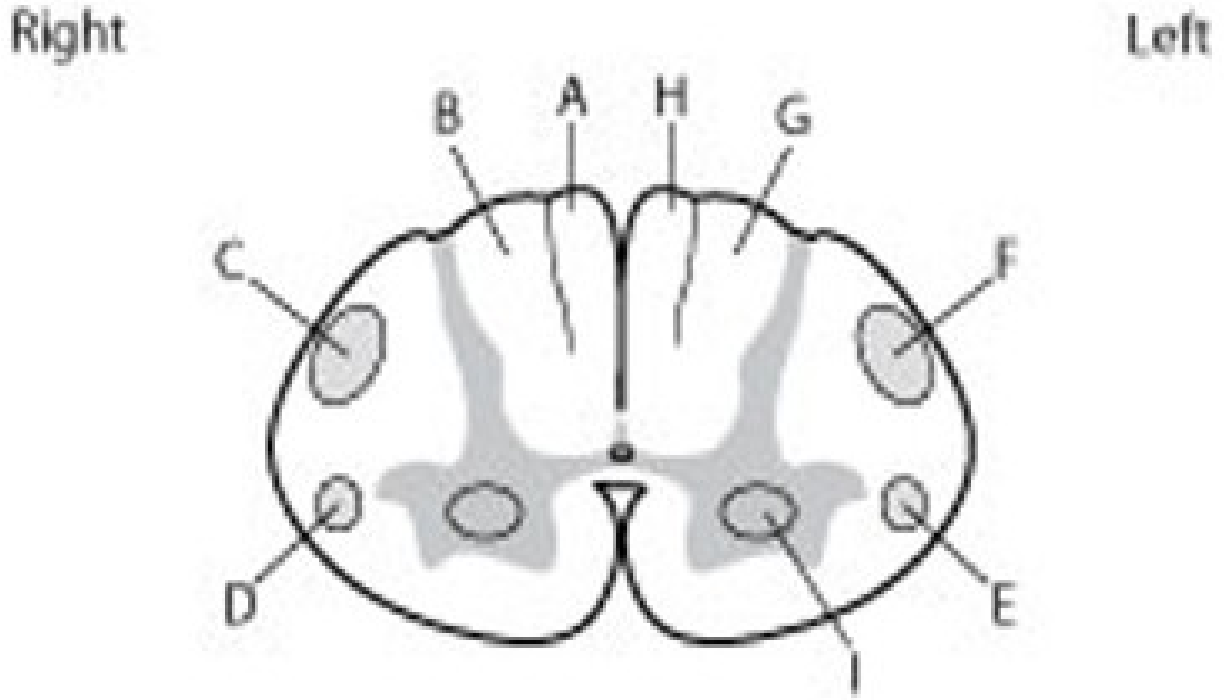
a. A
b. B
c. C
d. H
e. G



Quiz

A patient has left sided spastic paralysis, hyperreflexia and Babiniski sign. What is the most likely location of the lesion?

a.C
b.D
c.E
d.F
e.H



Quiz

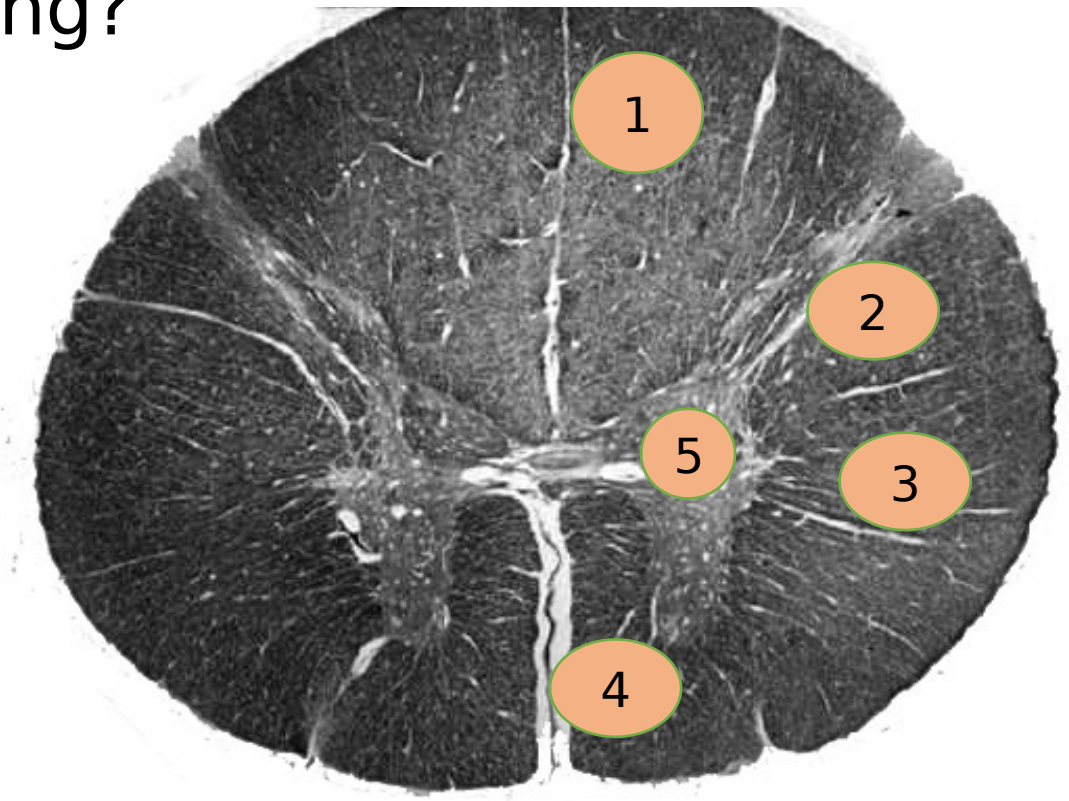
A 57 year old man has a tumor that is compressing the spinal cord. The mass has caused a loss of discriminative touch sensations from the skin of the back. The rest of the neurological exam is normal. Which of the following is the tumor most likely compressing?

- A. Dorsal part of the cord
- B. Lateral part of the cord
- C. Ventral horn
- D. Several dorsal rami
- E. Cauda equina

Quiz

A 57 year old man has a tumor that is compressing the spinal cord. The mass has caused a loss of discriminative touch sensations from the skin of the back. The rest of the neurological exam is normal. Which of the following is the tumor most likely compressing?

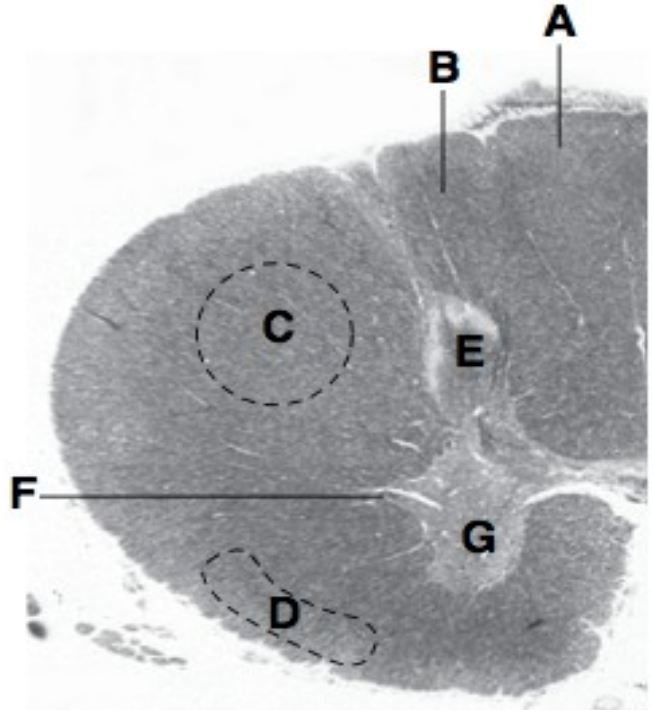
a.1
b.2
c.3
d.4
e.5



Quiz

A patient presented with muscle fasciculations. What is the most likely location of the lesion?

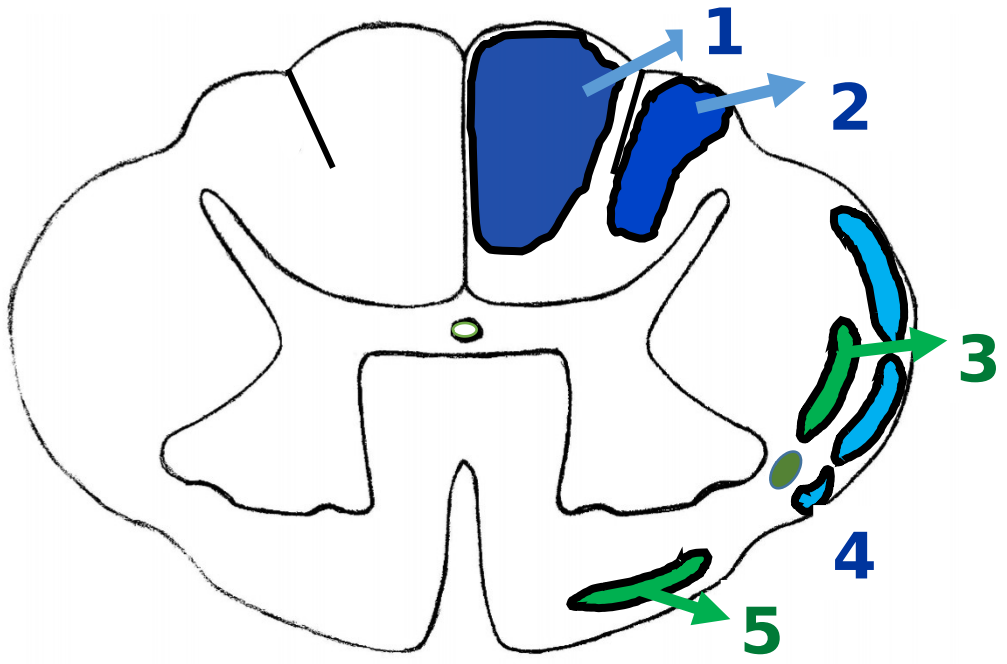
a.A
b.C
c.E
d.F
e.G



Quiz

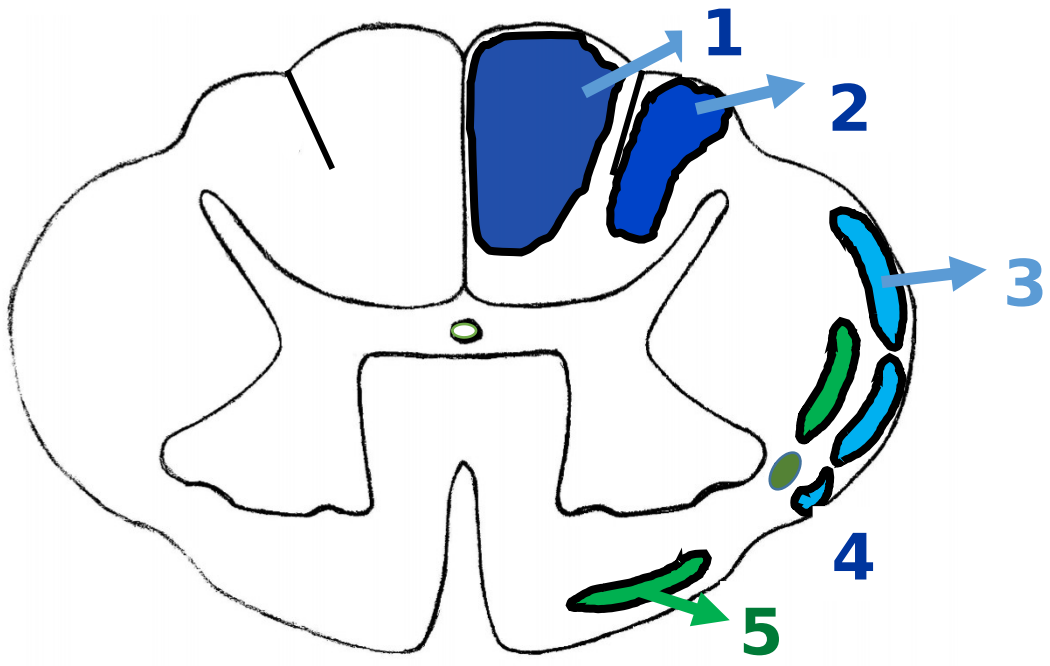
A patient presented with a loss of pain sensation in his right leg due to spinal cord injury. What is the most likely location of this lesion?

a.1
b.2
c.3
d.4
e.5



Which of the following carry/carries unconscious proprioceptive information?

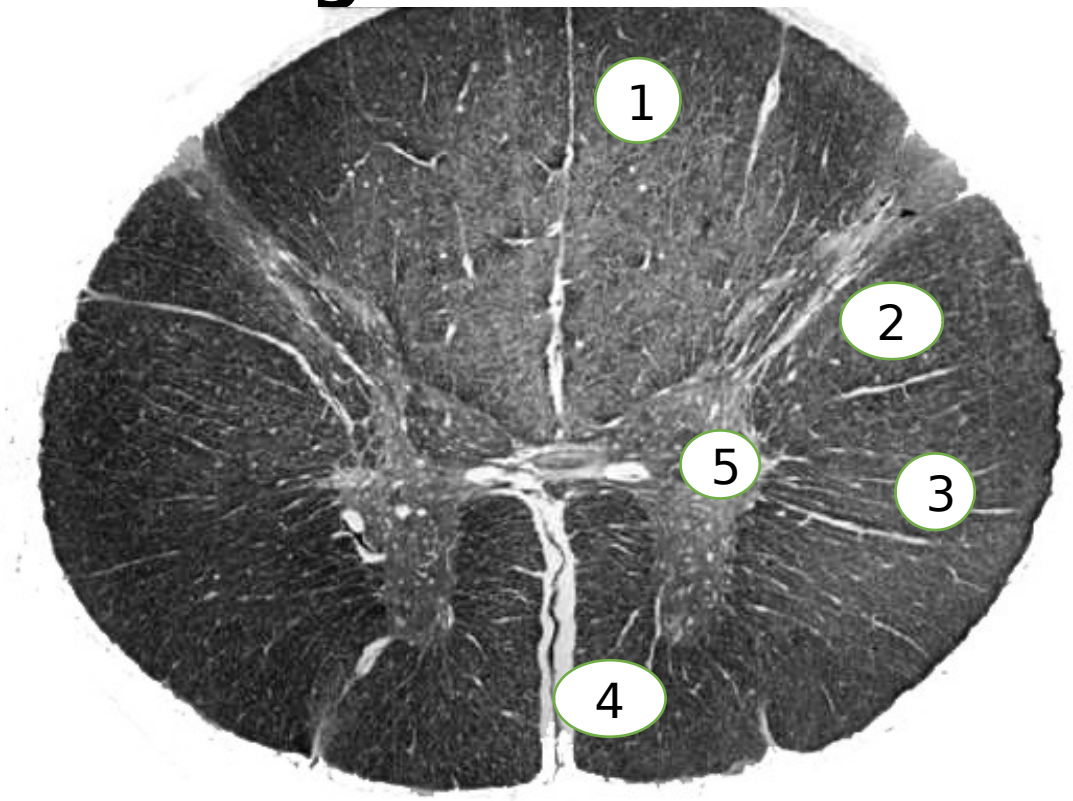
a.1
b.2
c.3
d.4
e.5



Quiz

A 37-year-old man presented with right Horner's syndrome. Which of the following is the location of the lesion?

a. 1
b. 2
c. 3
d. 4
e. 5



Quiz

The intermediate zone of the cord gray matter contains which of the following?

A- Dorsal root ganglion cells
B- Gamma motor neurons
C- Lower motor neurons
D- Preganglionic sympathetic neurons
E- Upper motor neurons

Quiz

Following an automobile accident that injuries his back, a 35-year-old man develops radiating pain in his lower back. The pain is accompanied by weakness in both of his legs. He notes some anesthesia of his perianal area. He also now has difficulty starting a stream of urine. CT studies show a bony fragment from the L3 vertebra that has been pushed backward and is compressing the subarachnoid space. The compression of which of the following structures may cause his symptoms?

- A. Atlas
- B. Axis
- C. Cauda equina
- D. Spinal cord
- E. Vertebral artery

Quiz

Motor nuclei are present in which lamina of the spinal cord?

a. Lamina V
b. Lamina VI
c. Lamina VII
d. Lamina VIII
e. Lamina IX

Main sensory nucleus corresponds to which lamina (e) of the spinal cord?

a. Lamina V only
b. Lamina VI & VII
c. Lamina III & IV
d. Lamina VIII only
e. Lamina I only

Quiz

A child burns her index finger on the stove. Where do the nerves that detect this sensory information first synapse?

A. Dorsal horn

B. Dorsal root ganglion

C. Nucleus cuneatus

D. Ventral horn

E. Ventroposterolateral nucleus of the thalamus (VPL)

Quiz

A 14-year-old girl is referred to a pediatric neurologist after an emergency room physician notes that she experienced almost no pain after badly burning her forearm while cooking. On neurologic examination, the girl is found to have loss of pain and temperature sense on the ulnar surface of both forearms, while light touch, vibration, and position senses are preserved. MRI examination of the spinal column demonstrates a 1-cm mass of the interior of the high thoracic spinal cord, above which there is a 1.5-cm, fluid-filled dilatation of the area of the central canal. Later resection of the mass demonstrates an ependymoma. In this patient, the pattern of sensory loss is most likely to be due to involvement of which of the following?

- A. Anterior horn
- B. Anterior white commissure
- C. Dorsal spinocerebellar tract
- D. Fasciculus gracilis
- E. Lateral corticospinal tract

Quiz

Poliovirus results in lower motor neuron muscle lesion. Which of the following cells in the gray matter is affected in this case?

a. Clarke’s nucleus
b. Substantia gelatinosa of Rolandi
c. Anterior horn motor nuclei cells
d. Intermediomedial nucleus
e. Renshaw cells

Quiz

Tetanus toxin results in muscle spasm and lock jaw. Which of the following cells in the gray matter is affected in this condition?

a. Clarke’s nucleus
b. Substantia gelatinosa of Rolandi
c. Anterior horn motor nuclei
d. Intermediomedial nucleus
e. Renshaw cells

Quiz

Calculator QUESTION 4

Which of the following carry/carries unconscious proprioceptive information?

A. Anterolateral system

B. Corticospinal tracts

C. Dorsal columns

D. Spinocerebellar tracts

E. Spinothalamic tracts

Quiz

Which one of the following spinal cord levels has thick anterior and posterior horns?

a) Cervical
b) Upper thoracic
c) Lower thoracic
d) Lumbar
e) Conus medullaris

Quiz

A 37-year-old woman presents with a suspected Schwannoma. The radiology report indicates “a soft tissue mass to the right of L1 at the level of the L1 to L2 neural foramen.” The neurologist presses the base of a vibrating 128 cps tuning fork to the skin of the patient’s right and left thighs and asks her to describe the sensation. She asks the patient to close her eyes and then to tell her whether the tuning fork is vibrating or not. With that instrument the doctor is primarily testing the function of which of the following sensory receptors?

a. Pacinian corpuscles
b. Kraus end bulbs
c. Meissner corpuscles
d. Merkel cells

Quiz

A 40-year-old patient complains of difficulty maintaining balance. Upon neurological examination, there was impaired proprioception. The physician decided to examine the sensory receptor responsible for detecting changes in muscle length. Which of the following is a characteristic histological feature for this receptor?

a. Contains single type of flattened cells
b. Cells with distinct striations in their peripheral part
c. Its cells contain single central vesicular nucleus
d. It is un-encapsulated
e. Contains nerve fibers between collagen fibers

Quiz

A neurologist is examining the pain sensation in a patient with hemiplegia. Which type of sensory receptor is likely responsible?

a. Pacinian corpuscles
b. Ruffini corpuscles
c. Meissner corpuscles
d. Merkels disc
e. Free nerve endings

Quiz

A 60-year-old man presents with hemiplegia. The neurologist examines the pain sensation in his hands. Which of the following is a character of the receptor responsible for receiving this sensation?

a. Encapsulated by thick connective tissue capsule
b. Unbranched myelinated single fiber
c. Thickly myelinated nerve branches
d. Its end shows a dilated disc
e. Unmyelinated branching nerve fibers

Quiz

A 37-year-old woman presents with a suspected Schwannoma. The radiology report indicates “a soft tissue mass to the right of L1 at the level of the L1 to L2 neural foramen.” The neurologist presses the base of a vibrating 128 cps tuning fork to the skin of the patient’s right and left thighs and asks her to describe the sensation. She asks the patient to close her eyes and then to tell her whether the tuning fork is vibrating or not. With that instrument, which of the following is a character of the sensory receptors tested by the doctor?

a. Unmyelinated nerve fibers branching between collagen fibers
b. Rounded with branching unmyelinated nerve ending
c. Transversely arranged Schwann cells with myelinated fiber

Quiz

A 32-year-carpenter complains of a loss of sensitivity to shape and nature of objects. Neurological examination showed defective tactile localization. Which type of sensory receptor is responsible for this fine sensation?

a. Pacinian corpuscles
b. Ruffini corpuscles
c. Meissner corpuscles
d. Merkel’s tactile disc
e. Free nerve endings

Quiz

Which one of the following is a character of the Merkel`s tactile discs?

a. They are found between the Schwann cells.
b. Merkel`s cells are connected to epidermal cells by hemidesmosomes.
c. They are non-encapsulated receptors.
d. The nerve fiber forms basket arborization
e. The nerve fiber form a spiral pathway

Quiz

You are examining the receptors of vibration sensation in a section in the skin dermis. What is the characteristic feature the help you to identify this receptor?

a. Spiral course of the nerve
b. Transverse arrangement of Schwann cells
c. Concentric arrangement of Schwann cells
d. Dilatation of the nerve ending forming Merkel’s disc
e. Parallel arrangement of collagen

Quiz

Which of the following is a character of Merkel's cell?

a. They are found deep in the dermis.
b. Connected to epidermal cells by desmosomes.
c. They are encapsulated.
d. Surrounded by nerve fiber in a spiral form.
e. Surrounded by Schwan cells arranged in concentric layers

Quiz

A 37-year-old woman presents with a suspected Schwannoma. The neurologist is examining the tactile localization sensation perceived by a receptor in the papillary dermis. Which of the following is the histological structure of the sensory receptors examined in this case?

a. Contains a single unbranched unmyelinated nerve
b. Rounded structure with unmyelinated nerve branching between collagen fibers
c. Spirally branching nerve fiber between modified Schwann cells
d. Unmyelinated nerve fiber branching between epidermal cells
e. Myelinated nerve fibers surrounded by concentric layers of Schwann xells

Quiz

Which of the following receptors are responsible for detecting the tensions produced by muscle contraction?

a. Pacinian corpuscles
b. Ruffini corpuscles
c. Meissner corpuscles
d. Muscle spindle
e. Golgi tendon organ

Quiz

A 45-year-old man with a history of a stroke comes to the physician for a follow-up examination. Physical examination shows hyperreflexia of the patellar tendon tap. The spasticity reflects loss of inhibitory influences that normally limit responses to afferent signals that convey information about muscle stretch. Which of the following structures within the muscle actively initiates the abnormally brisk patellar reflex arc in this patient?

- A. Extrafusal fibers
- B. Golgi tendon organs
- C. α-Motor neurons
- D. γ-Motor neurons
- E. Spindle afferents

Quiz

Presynaptic terminal is distinguished from postsynaptic membrane by which of the following character?

a. It possesses transmitter receptors.
b. It contains neurotransmitter vesicles.
c. Its cell membrane exhibits depression.
d. Its nerve fiber terminal forms basket arborization.
e. It contains choline esterase enzyme.

Quiz

Which of the following is a characteristic of the postsynaptic membrane?

a. It possesses transmitter receptors.
b. It contains neurotransmitter vesicles.
c. Its shows terminal expansion.
d. It forms basket arborization.
e. It contains choline esterase enzyme.

Quiz

Gap junctions are characteristically associated with which of the following?

a. Axodendritic synapses
b. Axoaxonic synapses
c. Axosomatic synapses
d. Dendrodendritic synapses
e. Electrical synapses

Quiz

Calculator

QUESTION 2

A lesion of the right lateral corticospinal tract of the spinal cord will most likely cause which of the following?

- ○ A. Left-sided flaccid paralysis at the level of the lesion
- ○ B. Left-sided loss of touch and vibratory sensation below the lesion
- ○ C. Left-sided spastic paralysis below the lesion
- ○ D. Right-sided flaccid paralysis at the level of the lesion
- ○ E. Right-sided loss of touch and vibratory sensation below the lesion
- ○ F. Right-sided spastic paralysis below the lesion

Quiz

A 30-year-old man presents a feeling of constant pressure. Which sensory receptor, located in the subcutaneous tissue, is responsible for detecting deep pressure?

a. Free nerve ending
b. Pacinian corpuscle
c. Muscle spindle
d. Meissner's corpuscle
e. Ruffini corpuscle

Quiz

Calculator QUESTION 5

Which of the following symptoms would most likely occur after a lesion of the ventral horn of the spinal cord?

A. Fasciculations

B. Hyperreflexia

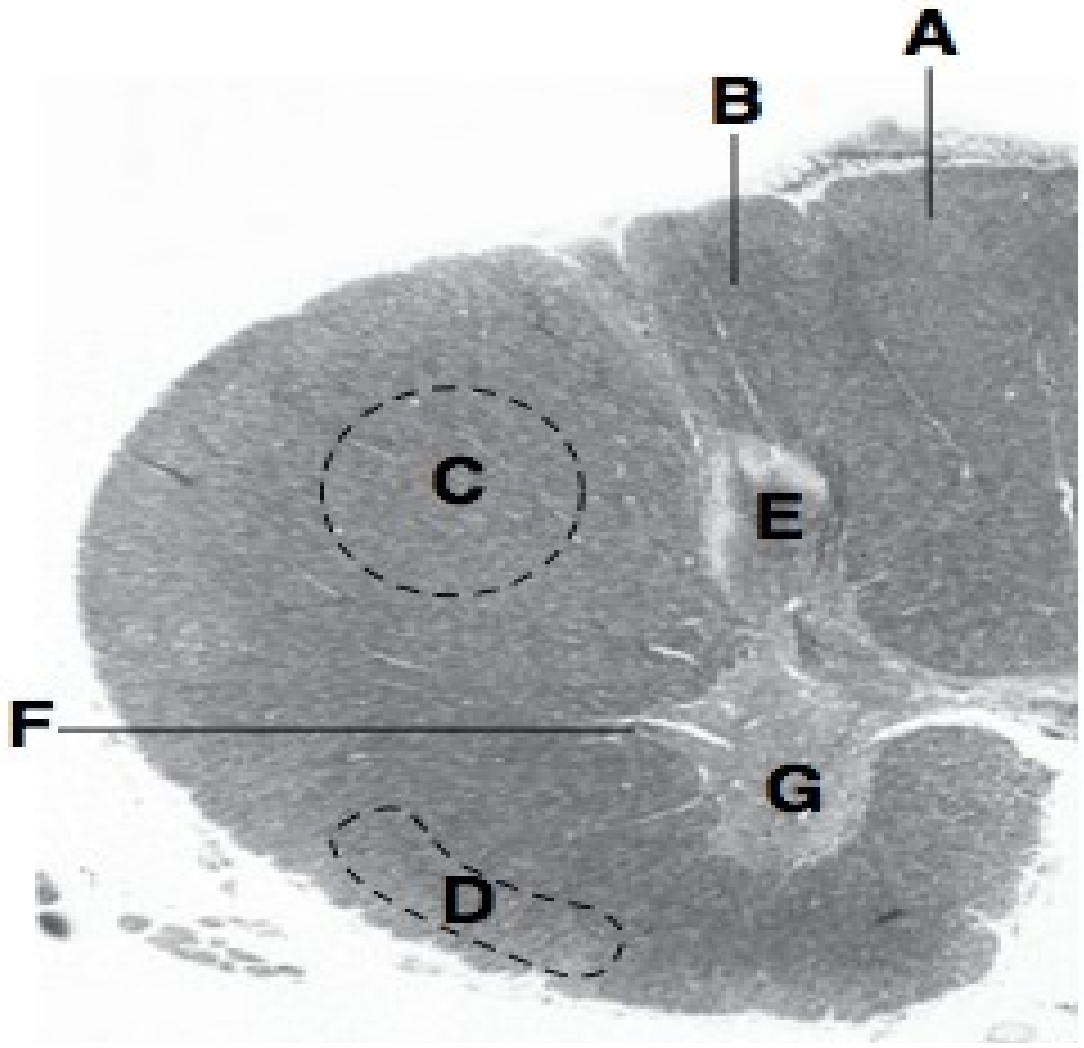
C. Loss of pain and temperature sensation

D. Loss of tactile discrimination

E. Spastic paralysis

Quiz

Identify points A-G of the spinal cord cross section below.



Quiz

A 25-year-old patient experiences a tingling sensation while lightly stroking the skin. The sensory receptor specialized for detecting light touch is characterized by which of the following?

a.Un-encapsulated

b.Abundant in the skin of abdomen

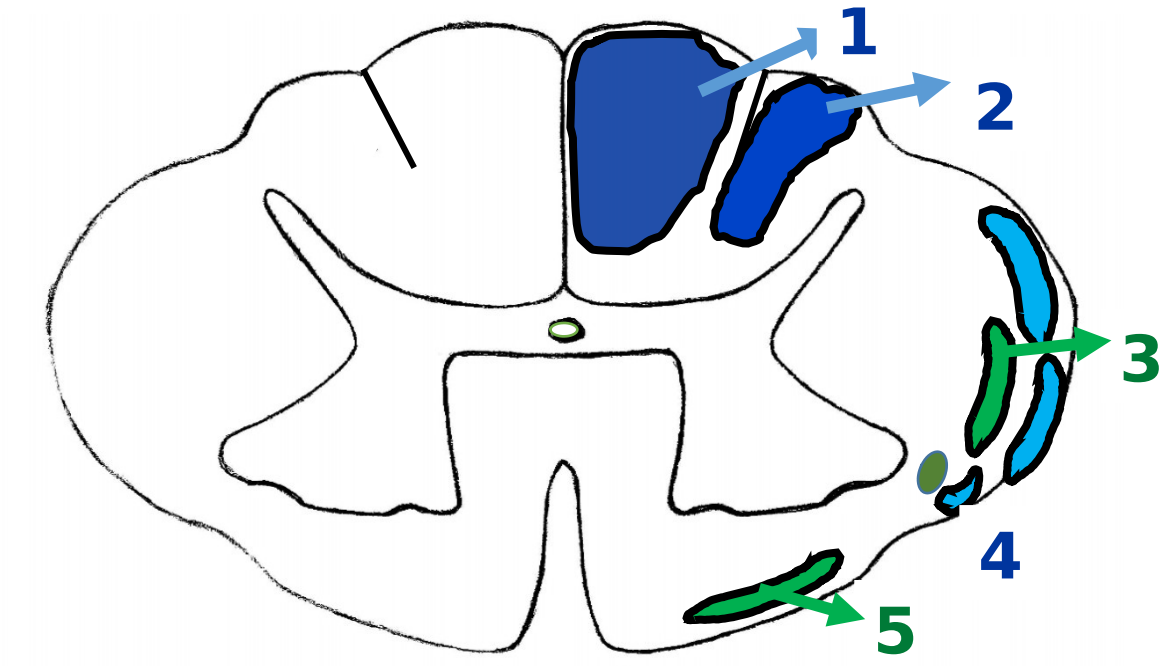
c.Contain concentric layers of Schwann cells

d.Present in dermal papillae

e.Afferent nerve end in club like structure

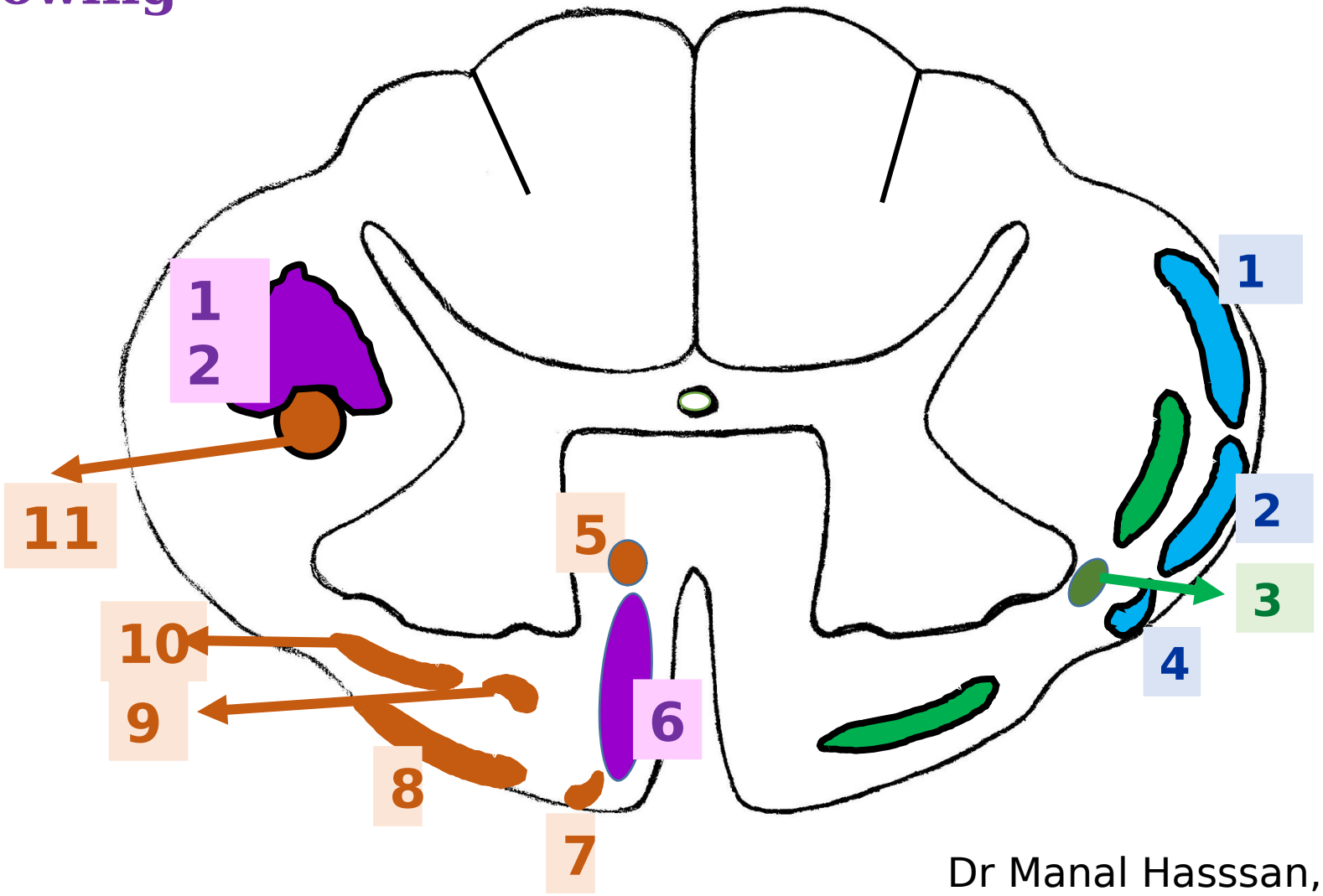
Quiz

Label the following diagram



Quiz

Label the following diagram



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Quiz

Which of the following best describes the Clark's nucleus?

a. It has central nucleus.
b. It is multipolar cell.
c. It contains few Nissl's granules.
d. Present in spinal cord levels C6-L3
e. Corresponds to lamina VII

One of the following is NOT a character of the Merkel`s tactile discs:

A. They are found between the epidermal cells.
B. Merkel`s cells are connected to epidermal cells by desmosomes.
C. They are encapsulated receptors.
D. The nerve fiber forms tactile meniscus.

One of the following is NOT a character of Meissner's corpuscle:

A. It is an encapsulated nerve ending
B. It is present in dermal papillae.
C. The Schwann cells are arranged in two cores.
D. The nerve fibers run spirally between the Schwann cells

Quiz

What are the Nuclei of the dorsal horn?

What are the ascending tracts present in the lateral white columns?

Describe the histological structure of alpha motor neurons

Motor nuclei in anterior gray horn are classified into: ……., …….

Lateral group of nuclei in AHC in cervical level include ……., ……., …….

Quiz

Compare between:

1. Alpha (α) neurons & Gamma (γ) neurons.

Alpha neurons	Gamma neurons
-Large multipolar cells -Prominent Nissl granules. -Their axons (α efferents) innervate extrafusal skeletal muscle fibers.	smaller cells. -Their axons (γ efferents) supply intrafusal muscle fibers of muscle spindle.

2. Compare between Pacinian & Meissner's corpuscles

	Pacinian corpuscle	Meissner's corpuscle
Site	Dermis and hypodermis, pancreas, mesentery, breasts, external genitalia wall of the urinary bladder, periosteum, tendons and joint capsules	Dermal papillae of skin of palms, finger tips, soles, lips, nipples, eyelids and external genitalia i.e. mainly in non-hairy (glabrous) skin.
Afferent n.	A myelinated afferent nerve fiber which loses its myelin sheath at the first node of Ranvier just inside the corpuscle	Loose its myelin inside
Aff. n. course	afferent fiber runs axially to terminate by a club-like termination	Branch and run in a spiral course in between the flattened Schwann cells. terminate by expanded ends or knobs
Schwann cells	Numerous concentric layers of flattened modified Schwann cells surrounding the afferent n.	Transversely arranged stacks of flattened modified Schwann cells
Function	Respond to deep pressure and vibration	Respond to two points tactile discrimination.

Thank
you